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IMPROVED METHOD OF CO-ORDINATING A GROUP OF TOYS

Field of the Invention

- 5 The present invention relates to an improved method of co-ordinating a group of toys such that they are able to interact without human intervention. In particular, the improved method enables interaction between toys that more accurately simulates human interaction.

10 Background of the Invention

Interactive toys have been known for some time and have been manufactured and sold commercially by various companies. Generally, interaction of these types of toys has been between the human operator, or child, and the toy.

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In its most basic form, an interactive toy includes recorded speech that may be replayed upon the command of the child. This type of interactivity has been well known for many years and is currently provided in toys in the form of signals recorded in a memory device for playback through a speech playback device.

- 20 Replay of pre-recorded speech from the toy has generally been commanded by the press of a button but more recently has included the sensing of a transducer condition to invoke the playback of speech.

This limited form of interaction has obvious disadvantages in that children
25 become familiar with the pre-recorded speech sessions of the toy and the circumstances in which particular sessions are replayed. With growing familiarity of the toys ability to interact with the child and its surroundings, and repetition of responses to the child, the child becomes increasingly disinterested in the toy.

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In order to increase the likelihood of retaining the child's interest, the concept of toys interacting with other toys was developed.

Whilst the concept of toys interacting with other toys has the potential to greatly improve the length of time before the child becomes dis-interested in the toy, technically, it is significantly more difficult to achieve as compared with the
5 simple playback of pre-recorded speech sessions.

A previous attempt to provide interactivity between toys is disclosed in US4,857,030 (Rose) wherein a toy capable of conducting a simulated conversation with another toy is described. Each toy contains a digital to analog
10 converter, a memory for storing speech data in digital form indicative of words and phrases and a speaker coupled to the digital to analog converter to produce synthesized human speech. The method of communication as described in Rose limits conversation to only two active participants, a primary speaker and a primary responder with all other toys in the vicinity locked out of the
15 conversation. At any one time, the primary speaker and the primary responder are only ever aware of each other and are ignorant of the presence of any other toys in their vicinity.

The limited form of interaction described by Rose fails to simulate diversity of
20 behaviour such as that experienced in most human interactions. In particular, humans generally congregate in communities and conduct conversations where any member of the group can contribute. This is certainly the case for social gatherings which children are most likely to be interested in simulating. In addition, humans will generally form groups within a larger community based
25 upon the common interests of members in the group or the desire to learn about another human or group.

As such, it is an object of the present invention to provide an improved method of co-ordinating a group of toys that provides for the toys to more accurately
30 simulate human interaction.

The invention as described herein makes use of the basic speech synthesis elements of well known toys. Accordingly, a toy according to the present invention includes a digital to analog converter, memory for storage of speech in digital form indicative of words and phrases and a speaker coupled to the digital
5 to analog converter to generate human synthesized speech. Whilst speech is a very important part of human interaction, the invention is not limited to simulating human conversations and equally applies to physical interaction as well as a combination of both.

10 Improved interaction between toys will enhance the value of the toy to the child and will promote the forming of groups amongst children with similarly capable toys to watch, enjoy and participate in the interaction of their toys.

Even though an improved ability to interact with other toys will retain the child's
15 interest for a greater period of time, the child may eventually become familiar with the toys interactive behaviour in certain circumstances or in certain groups of toys.

Accordingly, it is another object of the present invention to provide an improved
20 method for co-ordinating a group of toys wherein the toys are able to modify their interactive behaviour in accordance with the desire of the child or as a result of interaction with other toys. In this way, toys can learn from other toys and hence the interactive behaviour of the toy may be modified as a result of the exposure of the toy to a particular toy or group of toys. Similarly, the toy may
25 have its interactive behaviour modified by altering or expanding the pre-recorded speech stored in its memory.

The above discussion of documents, acts, materials, devices, articles or the like is included in this specification solely for the purpose of providing a context for
30 the present invention. It is not suggested or represented that any or all of these matters formed part of the prior art base or were common general knowledge in

the field relevant to the present invention as it existed before the priority date of each claim of this application.

Summary of the Invention

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The present invention provides an improved method of co-ordinating a group of toys wherein a network of toys may be formed including two or more toys, with at least some of the toys including a storage means to store speech data and/or motion data, selection means to select data from the storage means, transducer
10 to effect playback of stored speech data and/or transducer to effect motion of the toy in accordance with motion data and a transmitting and receiving means, the method including the steps of each toy transmitting identity information to all other toys in its transmission/reception vicinity and receiving identity information from all other toys in its transmission/reception vicinity.

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Preferably, each toy in the network stores a list, or table, of the identity of all the other toys currently in the network and maintains that list as toys enter or leave the network. Clearly, the identification means of each toy should be unique such that each toy may specifically address another toy, or group of toys, for
20 communication purposes.

It is preferable that the transmission of a first toy's identification information to other toys occur at the time the first toy initially enters the vicinity of the other toys. It is also preferred that the first toy receives identification information
25 regarding the identity of the other toys at approximately the same time as transmitting its identity information to other toys. In this way, the first toy entering the vicinity of other toys transmits its identity to the other toys enabling them to establish and store the identity information of the first toy, the other toys thereby recognising the presence of the first toy in the network of toys. Similarly,
30 upon receiving identification information relating to the other toys, the first toy may then establish and store the identity information relating to all the other toys

in the network, the first toy thereby recognising the presence of all the other toys in the network.

5 In order to better facilitate the maintenance of a list of each and every toy currently in a network, preferably, when a toy ceases to be an active member of a network, the toy transmits a signal to indicate its exit from the network. This would enable the remaining toys to modify their stored list accordingly. Each toy may transmit a signal indicating its exit from the network in circumstances where the toy may be experiencing a loss of electrical energy supply, for
10 example due to weakening charge of installed batteries, or where the toy is simply de-activated by the child operator. As an exit from the network may be difficult to predict in circumstances where a change in the proximity of the toy may result in the toy no longer being an active member of the network, it may be preferable to establish a communication protocol that establishes the
15 presence or otherwise of each participating toy in the network prior to transmitting a signal to that toy. Of course, it would also be possible to include both techniques.

In addition to storing basic identification information of each toy in the network, it
20 would be preferable to store additional information relating to the pre-stored speech sessions of each toy.

Preferably, pre-stored speech sessions include additional information relating to the structuring of the pre-stored speech in order to conduct a simulated human
25 conversation. Such a store of speech phrases and the additional information for structuring the phrases to simulate intelligent conversation effectively forms a "topic". There are various techniques including decision tree logic algorithms, that can be used to structure speech phrases such that they can accommodate a variety of statements and responses and thus be used to conduct a seemingly
30 intelligent conversation between similarly equipped toys. In particular, it is preferred that the topics be formed and a communication protocol be adopted to accommodate conversation between any number of participants. Two or more

toys containing information relating to the same topic may then converse about that topic. During the simulated conversation, signals may be transmitted between the toys to indicate the various speech phrases that have been selected for playback through the toy's speaker. Signals to indicate such
5 selections enables toys to follow the thread of conversation through the topic as the conversation progresses and also enables each toy participating in the conversation to contribute to the discussion.

Of course, each topic does not necessarily relate to speech only and may
10 include physical actions of the toys as well.

To improve the simulated interactive ability of a toy, it is preferable that a toy be able to store information relating to a number of topics such that it may simulate conversation with other toys in relation to a variety of topics. It is further
15 preferable that the operator of each toy have the ability to modify the storage of topics such that they may tailor the topics stored by the toy to include topics that are of particular interest to the operator. Accordingly, it is preferable that information identifying the pre-stored topics contained within each toy be transmitted to other members of the network in addition to its basic identification
20 information. Effectively, the pre-stored topics in the toy form part of the toy's identity. In a particularly preferred embodiment, toys may even obtain the detailed speech phrases and decision logic from other similarly equipped toys either under direct control of the operators or whilst interacting as part of a network. This aspect of the invention enables the toys to simulate learning
25 behaviour.

In order to more accurately simulate human interaction, it is preferable that participating toys have the ability to form groups within the network such that they can converse about particular topics. Accordingly, if groups are formed, it
30 would be preferred that information regarding the active topic of discussion in those groups be transmitted to each and every toy in the network at the time of forming that group. Additionally, it is also preferable that information relating to

the active topic of each group be transmitted to new toys entering the network thus enabling each new toy to select a group to join depending upon the currently selected active topic of each group.

- 5 At any time, a toy may elect to enter or exit a group and preferably a signal is transmitted to all other toys in the network to indicate the toys mobility through groups in the network. Such signal transmissions would enable each member toy of the network to maintain current information regarding all other active participants in the network.

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Additionally, to further improve the accuracy of simulation of human interaction, each toy may propose a different active topic for a group or alternatively may poll the other members of the network to establish a new group based upon a common topic.

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- In a particularly preferred embodiment, the invention uses a protocol referred to as the Mobile Ad-hoc Network (MANET) protocol to implement the management of communication between toys in the network. In applying this protocol and its control and communication mechanisms to a network of toys, the "network layer" may be considered as a composite of all toys in the network with each toy being considered as a "computing node" as well as a "network router".
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- The invention also provides a toy capable of forming a network with at least one other toy including a storage means to store speech data and/or motion data, selection means to select data from the storage means, transducer to effect playback of stored speech data and/or transducer to effect motion of the toy in accordance with motion data and a transmitting and receiving means, wherein the toy, when operable, transmits identity information to other toys in its transmission/reception vicinity.
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Preferably, the toy of the present invention also receives identity information from other toys in its transmission/reception vicinity. It is further preferable that

the toy, when about to cease operation, transmits a signal to other toys in its transmission/reception vicinity to indicate its pending cessation of operation.

5 In a particularly preferred embodiment, the toy of the present invention maintains a store of identity information with respect to the other toys in its transmission/reception vicinity.

10 In one embodiment, a network of two or more toys is formed wherein communications between the toys are managed in accordance with the Mobile Ad-hoc Network Management (MANET) protocol.

In the preferred embodiment, the tasks associated with forming a co-ordinated group of toys and effecting communication and interaction there between is considered to consist of five functional layers.

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The five layers in which various functions are performed are referred to as:

1. Dynamic Group Formation, Maintenance and Disbanding;
2. Active Topic Selection;
- 20 3. Topical Message Passing;
4. Topical Knowledge Encoding; and
5. Message Cue Response.

25 **1. Dynamic Group Formation, Maintenance and Disbanding**

In the preferred embodiment, this functional layer uses the Mobile Ad-hoc Network (MANET) protocol to form an ad-hoc network of toys.

30 In the terminology of the MANET protocol, the "network layer" is considered to comprise a composite of all the toys in the network. In addition, each toy in the network may be considered to be a "computing node" as well as a "network

router". Each toy may have an identifier referred to as the "Toy Identifier" and messages may be routed from one toy to another using this identifier.

5 Establishment of a network of toys in the preferred embodiment includes the transmission of identification information by each toy in the network to the other toys in the network. Upon initial formation of a network of toys, each toy transmits detailed information regarding its identity and receives and stores the detailed identity information received from other toys.

10 In this embodiment, this particular functional layer also includes the ongoing maintenance of the network of toys including the handling of new members and recognising the departure of existing members. In addition, this functional layer also manages the establishment and disbanding of groups. The maintenance function of the network never ceases and continues until the entire network is
15 disbanded.

The resultant network established is a network of toys that communicate on a peer to peer basis.

20 2. Active Topic Selection

In the preferred embodiment of the invention, having established a network wherein each toy is aware of the presence of all other toys in the network, the toys attempt to discuss or converse about a common topic of interest. They may
25 also carry out a co-ordinated activity such as playing a game or acting out a mock combat. In any event, any co-ordinated activity is generally performed in relation to some form of shared knowledge referred to herein as the "Active Topic".

30 In this embodiment, each toy has only one active topic at any point in time. However, due to the ability to form groups, there may be more than one active topic in the overall network of toys. Minimally there should be at least two toys

with a common topic for them to exchange messages. In the preferred embodiment, a toy may change its Active Topic in the middle of a conversation or activity.

- 5 Toys may select their active topic in various ways. In the preferred embodiment, each toy selects its active topic as follows. After the initial formation of a network, each toy communicates detailed identity information about itself to the other toys. This identity information consists of the toy's personal data such as the owner's name, the toy's place of origin, its likes and dislikes, and the pre-
- 10 stored topics that the toy can converse about. A topic can be a subject of conversation, or name of a game, song or play. After receiving the identity information from the other toys, each toy executes a function referred to as the Active Topic Selection Function. This function selects an Active Topic for the toy. This function could be implemented by way of a simple rule or alternatively
- 15 a sophisticated heuristic. As a simple rule, the function could select a topic at random from Interested Topics of other toys. Alternatively, the function could employ a sophisticated heuristic which determines a selection based upon various factors including the topics of interest of the other toys, its own topics of interest, the currently active topic, the toy's pre-stored personal preferences
- 20 with respect to topics or memory of its previous interaction with toys in the network. After a selection is made, the toy broadcasts the selected active topic to all the toys in the group. Other toys record this information to enable them to exchange messages with the toy if their active topics match the selected active topic of the toy. The selection of an Active Topic determines the group that the
- 25 toy is electing to join. If there is only a single Active Topic available then this indicates that there is only a single group and every toy in the network is participating in that group.

- In order to prevent the conversation or activity becoming too long and possibly
- 30 dis-interesting to the observer, a toy may alter the active topic by calling the Active Topic Selection Function again. Alternatively, the change could also be brought about by the toy owner activating the function with the press of a button

on the toy or by a natural language command in the case of a toy including a speech recognition system.

3. Topical Message Passing

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In the preferred embodiment, there are four primary message types. These are, point to point message, broadcast message, multicast message to a specified group of toys and multicast message targeted mainly to one toy with copies of the message to the other toys. Intended recipients of messages are selected by
10 way of their identifier. Broadcast messages are sent as normal broadcasts in a wireless network. Every message has a message header and a message body. The message header has information such as the FROM toy identifier and the TO toy identifier (except for broadcast message). The message body is a message string that may contain the entire message or alternatively simply a
15 number denoting a pre-determined message understood by all the toys.

4. Topical Knowledge Encoding

Topical knowledge is a term used herein to represent knowledge about any
20 topic of human activity. Specific examples are sports, entertainment, politics and effectively any topic that could be part of normal conversation. Topical knowledge could be more specific such as basketball, the java programming language, a particular movie or a dinner date that occurred recently. Topical knowledge is not limited to conversation. It may include any activity that
25 requires co-ordinated action on the part of the toys in the group. Examples are synchronised dancing, singing, interactive story telling, theatrical play, aerobic exercise or a military drill.

In the preferred embodiment, knowledge about topics is encoded in a persistent
30 storage means in an appropriate data structure. An example of how topical knowledge can be encoded in an inverted tree data structure is now described.

In this type of data structure, the root of the tree represents the starting point of conversation or activity for the toy. Conversation or activity proceeds downwards from the root of the inverted tree to its leaves. Every node in the tree represents a phrase or a sentence or a message about the topic. The links
5 between the nodes represent a term or condition that relates one node to another. For example, in a tree that encodes knowledge about a topic of conversation, each node may represent a sentence or utterance of response for the toy and each link may represent the words or phrases it may hear from other toys. Similarly, for a tree of synchronised dancing, each node may
10 represent a movement of a limb or any other body part, and each link may represent the movements of other toys in the group.

Topical knowledge can thus be encoded and stored in a persistent storage means, such as a computer file. In a particularly preferred embodiment of the
15 invention, stored topical knowledge may be downloaded to the toy via a computer or from the Internet. In addition, toy owners may encode topical knowledge about a particular topic including a song, a dance sequence, or a character's lines in a play. Toy owners may download such topical knowledge into their toy to predetermine its interactive behaviour to a certain extent. When
20 a group of toys programmed with the same topic or similar topics are brought together in an ad-hoc network, an interesting conversation or scenario may ensue.

5. Message Cue Response

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In the preferred embodiment, at any point in time a toy determines its next action using the Topical Knowledge encoded in the toy and the message received from other toys, or actions sensed from other toys. Electromechanical sensors such as touch sensors, pressure sensors, motion sensors, vision
30 sensors or speech sensors may be included in the toy for this purpose.

In this embodiment, the Message Cue Response function is effected as follows. The message cue response function maintains the current state of the toy's activity as the position of the node in the topical knowledge tree as given in the previous example. External messages received or actions sensed are then
5 tested with the condition term of each of the links from the current node. The link that satisfies the condition is then chosen as the next path. The node that the chosen link leads to is chosen as the next response or action of the toy. In this way, a toy may continue to act or respond to messages from other toys or actions sensed from other toys. As messages or actions of other toys in the
10 group influence each toy's response, a scenario that appears to be co-ordinated may emerge.

Detailed Description of the Preferred Embodiment of the Invention

15 A preferred embodiment of the method of the invention will now be described in relation to the accompanying drawings. However, it is to be appreciated that the following description is not to limit the generality of the above description.

In the drawings:

20

Figure 1 illustrates a wireless ad-hoc network of a group of toys;

Figure 2 details a "Use Case" diagram of some basic toy events;

25 Figure 3 is a scenario diagram for the particular Use Case of "Toys form a network";

Figure 4 identifies the format of an Identity Message (IM);

30 Figure 5 is an example of a Table of Active Topics;

Figure 6 is a scenario diagram for the Use Case of "A new toy enters the Active Topic group";

Figure 7 is a scenario diagram for the Use Case of "Toy Changes Active Topic
5 Group";

Figure 8 provides an example topical knowledge tree structure.

The preferred embodiment of the invention uses a protocol referred to as the
10 Mobile Ad-hoc Network (MANET) protocol to implement the management of communication between the toys in the network. In applying this protocol and its control and communication mechanisms to a network of toys, the "network layer" may be considered as a composite of all toys in the network with each toy being considered as a "computing node" as well as a "network router".

15

Figure 1 illustrates an example of an ad-hoc network of toys with each toy enclosed in a circle representing the transmission/reception vicinity of each toy.

Figure 2 details a Use Case diagram for the invention utilising the conventions
20 for such a diagram as described in the text "Object Oriented Software Engineering – A Use Case Driven Approach" published by Addison Wesley, Wokingham, England, 1992 and authored by Ivar Jacobson, Magnus Christenson, Patrik Jonsson and Gunnar Overgaard.

25 Each bubble in the diagram of Figure 2 represents a Use Case. Each Use Case represents a certain state or situation that may arise. All the Use Cases put together completely define the state of the network at any instant in time.

Use Cases 1 to 5 and Use Case 9 represent those states or situations that
30 require functions that reside in functional layers 1 and 2, those being the Dynamic Group Formation, Maintenance and Disbanding and Active Topic Selection. Use Cases 6 and 7 represent the states or situations requiring

functions residing within functional layer 3 referred to as Topical Message Passing and Use Case 8 represents the state or situation requiring functions residing within the functional layer 5 referred to as Message Cue Response.

- 5 A description of each of the Use Cases follows:

Dynamic Group Formation, Maintenance and Disbanding and Active Topic Selection

10 **Use Case 1: Toys form a network**

With reference to Figure 3, when two or more toys come together, an ad-hoc network of toys may be formed. The formation of the ad-hoc network utilises the Mobile Ad-hoc Network protocol and the control and communication
15 mechanisms contained therein.

Each toy has a pre-stored List of Interested Topics (LIT) in a memory means. In the preferred embodiment, each topic has an identifying name represented by a string of characters and numerals.

20

Having formed an ad-hoc network of toys, each toy selects an Active Topic (AT) for co-ordinated activity with other toys in that Active Topic group. A toy's AT is selected based upon the toy's pre-stored LIT and the AT of the other toys in the network.

- 25 During the formation of the ad-hoc network, each toy broadcasts a message called Identity Message (IM) which contains the toy identifier, its LIT and the toy's AT, if it has already chosen an Active Topic.

Use Case 2: Toy selects its Active Topic.

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Upon receiving an IM from other toys in the group, the toy executes a function called Active Topic Selection Function. This function may use some rules, preferences, heuristics or algorithm to select the AT for a toy. After completing

the execution of the Active Topic Selection Function, the toy broadcasts the selected AT to notify all the toys in the network.

5 In the preferred embodiment, each toy has a table of AT's and the names of the toys currently participating in that topic (refer to Figure 5). This table is called the Table of Active Topics (TAT).

After a toy selects and broadcasts its AT, each receiving toy then updates its TAT. This TAT is then used for message exchanges.

10

After the TAT is updated, each toy can initiate a conversation or activity in its AT by sending a message to toys that have the same AT. Rather than initiating a message, each toy may also wait for messages from other toys, and respond to those messages. Toys that share the same AT may then simulate human
15 interactivity by conducting simulated human conversations in relation to the AT.

Use Case 3: A new toy enters the Active Topic group

20 With reference to Figure 6, when a new toy enters an Active Topic group, the network layer notifies the entry of the new toy (with its toy identifier) to all the existing toys in the network. After the new toy selects its AT, it updates its TAT, and then broadcasts its AT to all members of the network. The other members may need to update their own TAT. From this point, the new toy would contribute to the conversation or activity pertaining to its AT.

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Use Case 4: Toy exits the Active Topic group

30 When a toy leaves an AT group in which it was previously participating, it broadcasts an Exit Message (EM) with its Toy Identifier prior to leaving the group. All the toys in the AT group receive this message and remove the name of the toy from the TAT. As a result they will not attempt to send any further messages to the toy that has left the group.

Upon ceasing to be a member of the network, the toy transmits an EM to all the toys in the network. All the toys in the network then update their respective TAT.

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In some circumstances, there may be inadequate time for the toy to send an EM. In such a situation, remaining toys in the network continue to send messages to the toy. If the sender toy receives no reply, it may re-send the message. However, after a number of specified resends, in the event of no
10 reply, the sender may automatically remove the toy from its TAT.

Use Case 5: Toy changes Active topic group

With reference to Figure 7, toys are able to change their currently selected AT.
15 The owner of the toy may also choose to change the AT by the press of a button on the toy. In either case, the toy broadcasts the new AT that it has chosen to all the toys in the relevant AT group.

Upon receiving this message, other toys may choose to call the Active Topic
20 Selection Function again with the new Active Topic as a suggested topic. This function decides whether or not to select the suggested topic as the toy's Active Topic. As described earlier, the selection function can simply be an arbitrary decision or a sophisticated heuristic taking into consideration the toy's interested topics, interested topics of other toys in the group or other relevant
25 information. If a toy decides to change its Active Topic, it broadcasts the new topic to all the toys in the group to notify them of the change. Upon receiving this broadcast, toys in the group update their respective TAT. Exchange of topical messages ensues from this point onwards.

30 Toys may also choose to ignore the call for changing AT and carry on with their current activity if they so desire.

Topical Message Passing

Use case 6: Toy sends a topical message to other toys

Once a network is formed, a toy can send a topical message to one particular
5 toy, a group of toys or all the toys. The Message Cue Response System
decides what message to send, to which toys, and what action to perform.
Using the toy identifiers available in the TAT, a toy addresses the message to
target toys.

10 Mainly four different messages are possible. They are, point to point message,
broadcast message, multicast message to a specified group of toys and
multicast message targeted mainly to one toy with copies of the message to
other toys. All the message types, except the broadcast type, are sent using
the toy identifier of the target toy address. Broadcast messages are sent as
15 normal broadcasts in a wireless network.

Every message has a message header and a message body. The message
header has information such as the FROM toy identifier and the TO toy
identifiers (except for broadcast message). The message body is a message
20 string that may contain the whole message or just a number denoting a
message understood by all the toys.

Although messages are sent as wireless data transmissions, a human
understandable form speech is also spoken aloud by the toy. For example, as
25 data is transmitted to a toy corresponding to a message to another toy to
request it to send its owner's name, but at the same time the toy may use its
voice synthesiser to say aloud "Hi Tom, Who is your partner?".

Use Case 7: Toy receives a topical message

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When a toy receives a message it is then passed to the Message Cue
Response Function executing upon the toy's computing means, which extracts

the sender's toy identifier and the parameters from the message. As explained in the section entitled "Message Cue Response", the message received is used to determine a relevant response and the target toys to which the response to be addressed. In addition, the Message Cue Response function may also
5 determine a relevant action for the toy.

Topical Knowledge Encoding

Knowledge about a topic of conversation or co-ordinated activity can be stored
10 in any suitable format. With respect to Figure 8, in the preferred embodiment, topical knowledge is stored in the form of a tree structure. The nodes of the tree represent the actions of the toy and the links represent the conditions.

The word action refers to either a message the toy sends to other toys a spoken
15 word, sentence or phrase; or a movement of the toy body parts by actuation; or any other actions such as sensing or the execution of instructions by the toy's computing means.

An example of an action as a spoken sentence (addressed to another toy) is:
20 "Hi Mike, how was your weekend?"

An example of action as a body movement (for the toy): move left, lift right hand over head and scream.

25 The term action may include a plurality of messages sent, words spoken or body movements made.

The term condition refers to a conditional statement including arithmetic and logical operators, rules, or steps of an algorithm. In the Message Cue
30 Response function (described in the next section), conditional statements are applied to the messages received from other toys, actions sensed from other

toys, the internal state of the toy in question, or various combinations or permutations thereof.

An example of a condition statement is:

- 5 If message from toy 2 contains any of these words {Hello, Howdy, Hi}
 send message "I'm fine, thank you".

Message Cue Response

10 Use Case 8: Toy decides its next response or action.

In the Message Cue Response Function, a toy selects the next action at each step in the decision tree using the Topical Knowledge Encoded in it and the previously received messages from other toys. An illustration of this concept
15 using the tree structure of Topical Knowledge Encoding is provided below.

With reference to Figure 8, at each decision point the message cue response system determines the next action to be carried out by the toy using the topical knowledge. The message cue response maintains a record of the current state
20 of the toy (in the topical knowledge tree) in the conversation or co-ordinated action that the toy is involved in. Any message received from other toys or actions sensed in other toys causes the message cue response system to apply that message or action to each condition applicable in the current state. If a condition holds true, the system determines that the toy should carry out the
25 action leading from the successful condition. In circumstances where more than one condition holds true, the system may arbitrarily choose one condition from all the various successful conditions.

A specific example may be provided with reference to Figure 8. If the toy is
30 currently in the state action 1.1, and it receives a message from some other toy, the received message is then applied to the condition 1.1 and 1.2. If condition 1.1 is true, the toy performs the action 2.1

Co-ordinated activity of the toy starts from the root of the tree denoted by action 0.0. Activity ends at any leaf of the tree, for example, action 3.5. and as such, activity flows from the root to a leaf. In Figure 7, an example of one possible
5 instance of activity flow is depicted by the arrow marks. In the example, the activity flows as follows: action 0.0 to action 1.2 to action 2.2 to action 3.5. Many different activities are possible with the same tree in conjunction with other toys and this depends on many factors such as topical knowledge encoded in other toys, variation in responses produced by other toys and the
10 individual characteristics or properties of the toy itself.

Finally, it should be appreciated that there may be other variations and modifications to the configurations described herein that are also within the scope of the present invention.

Claims:



1. An improved method of co-ordinating a group of toys wherein a network
5 of toys may be formed including two or more toys, with at least some of
the toys including a storage means to store speech data and/or motion
data, selection means to select data from the storage means, transducer
to effect playback of stored speech data and/or transducer to effect
motion of the toy in accordance with motion data and a transmitting and
10 receiving means, the method including the steps of each toy transmitting
identity information to all other toys in its transmission/reception vicinity
and receiving identity information from all other toys in its
transmission/reception vicinity.
- 15 2. A method according to claim 1 wherein the method includes the step of
each toy storing the identity of all the other toys in its vicinity.
3. A method according to any one of the preceding claims wherein the
method includes the step of each toy maintaining the store of identity
20 information as new toys enter the transmission/reception vicinity.
4. A method according to any one of the preceding claims wherein the
method includes the step of each toy maintaining the store of identity
information as toys leave the transmission/reception vicinity.
- 25 5. A method according to any one of the preceding claims wherein the
communication of identity information between toys occurs upon a new
toy entering the transmission/reception vicinity of the other toys in the
network.



6. A method according to any one of the preceding claims wherein the method includes the step of each toy attempting to transmit an exit message prior to the toy ceasing to be an active member of the network.
- 5 7. A method according to any one of the preceding claims wherein at least some of the toys include stored speech and/or motion data relating to a single topic thus forming topic information.
- 10 8. A method according to claim 7 wherein the at least some of the toys include actuators to effect physical movement of the toy and the topic information includes motion data that upon coupling to the actuators results in physical movement of the toy.
- 15 9. A method according to either of claims 7 or 8 wherein during simulated interaction, upon selecting data from the storage means to effect playback of speech and/or motion of the toy, a signal is transmitted to intended recipients to advise the selection of the data.
- 20 10. A method according to any one of claims 7 to 9 wherein topic information is stored in a form enabling each and every toy having a similar store of topic information to contribute to simulated interactivity thereby enabling multiple participants in a simulated interaction.
- 25 11. A method according to any one of claims 7 to 10 wherein at least some toys may store information relating to a plurality of topics.
- 30 12. A method according to any one of claims 7 to 11 wherein the identity information includes information relating to the topics about which the toy is capable of simulating interactivity.



13. A method according to any one of claims 7 to 12 wherein each toy storing the identity information of each and every other toy associates the topic information of the other toys with the identity information thereof.
- 5 14. A method according to any one of claims 7 to 13 wherein topic information may be transferred for storage in a toy under the control of the operator.
- 10 15. A method according to claim 14 wherein the transfer of topic information is by way of a communication link between the toy and a separate computing means.
- 15 16. A method according to claim 15 wherein topic information is downloaded from an information repository separate to the computing means.
17. A method according to claim 16 wherein the separate information repository is connected to the internet and capable of communicating therewith.
- 20 18. A method according to claim 14 wherein the topic information is downloaded from another toy.
19. A method according to any one of claims 7 to 13 wherein topic information is downloaded from another toy during simulated interaction.
- 25 20. A method according to any one of the preceding claims wherein communications between toys is managed in accordance with a network management protocol.
- 30 21. A method according to claim 20 wherein the network management protocol provides for the possibility that a toy to which communication is addressed may no longer be an active member of the network.



22. A method according to either claim 20 or 21 wherein the network management protocol includes the facility for the formation of groups of toys within the network of toys.
- 5
23. A method according to claim 22 wherein the method includes the step of forming a group of toys on the basis of a common topic.
24. A method according to either claim 22 or 23 wherein at any one time, a group will have only one single active topic about which the toys in the group simulate interactivity.
- 10
25. A method according to any one of claims 22 to 24 wherein the method includes the step of a toy exiting the topic group to which it belongs.
- 15
26. A method according to any one of claims 22 to 25 wherein the method includes the step of a toy entering a topic group having an active topic about which the toy has stored information.
- 20
27. A method according to any one of claims 24 to 26 wherein the method includes the step of transmitting information regarding the active topic of a group to every other toy in the network.
28. A method according to claim 24 to 26 wherein the method includes the step of transmitting information regarding the active topic of a group to every other toy in the network upon formation of the group.
- 25
29. A method according to any one of claims 24 to 28 wherein the method includes the step of each toy entering the network receiving information relating to the active topic groups formed within the network.
- 30



30. A method according to any one of claims 24 to 29 wherein the method includes the step of each toy entering the network selecting an active topic group to join whereupon it may participate in the simulated interactivity between the toys therein.
- 5
31. A method according to any one of claims 23 to 30 wherein the method includes the step of a toy in the group proposing a new topic for the group.
- 10
32. A method according to any one of claims 23 to 31 wherein the method includes the step of any toy in the network proposing the formation of a new group based upon a topic.
- 15
33. An improved method according to any one of claims 20 to 32 wherein the network management protocol is the Mobile Ad-hoc Network (MANET) protocol.
- 20
34. A toy capable of forming a network with at least one other toy including a storage means to store speech data and/or motion data, selection means to select data from the storage means, transducer to effect playback of stored speech data and/or transducer to effect motion of the toy in accordance with motion data and a transmitting and receiving means, wherein the toy, when operable, transmits identity information to other toys in its transmission/reception vicinity.
- 25
35. A toy according to claim 34 wherein the toy receives identity information from other toys in its transmission/reception vicinity.
- 30
36. A toy according to either claim 34 or 35 wherein the toy, when about to cease operation, transmits a signal to other toys in its transmission/reception vicinity to indicate its pending cessation of operation.



37. A toy according to any one of claims 34 to 36 wherein the toy maintains a store of identity information with respect to the other toys in its transmission/reception vicinity.

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38. A network of two or more toys, each toy according to any one of claims 34 to 37, wherein communications between the toys are managed in accordance with the Mobile Ad-hoc Network Management (MANET) protocol.

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